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Productivity Analysis Using the Multi Factor Productivity Measurement Model (MFPMM) as an Effort to Increase Competitiveness (Case Study: WL Alumunium Yogyakarta)

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Abstract

It is known that the national economy is dominated by Cooperatives and Micro, Small & Medium Enterprises (MSMEs), this proves that Cooperatives and MSMEs have competitiveness and potential that must be maintained. WL Aluminum is an MSME located in the Yogyakarta area which is engaged in the metal casting industry with products that include frying pans, *citel*, pans and other kitchen utensils. In order for a business to survive and continue to grow, it must be able to compete by preparing various strategies so that the products it produces will always exist in the market. One form of strategy that can be used is by measuring the company's productivity. This is used to determine the extent to which the effectiveness of the product produced and the efficiency of the use of available resources. Several variables that affect productivity include raw materials, energy and labor. The purpose of this research is to find out what the productivity index is for WL Aluminum using the MFPMM, and to find out whether there is an influence between the profitability received by WL Aluminum and productivity and price changes using the Multiple Linear Regression method. The results of productivity calculations using the MFPMM show that IP was in a row October-November 2015, November-December 2015; December-January 2016; January-February 2016; February-March 2016; March-April 2016; April-May 2016 of 1.0064; 1.2370; 0.8545; 0.9016; 0.9607; 1,1,068; 0.7348. The results of the mathematical equation using Multiple Linear regression are profitability (Y): -0.952+ 1.001 productivity (x1) + 0.951 price recovery (x2). Testing with the F test shows that the calculated F value is 1401891.948 with a significance value of 0.000 <0.05. This proves that profitability is influenced by productivity and price changes.

Keywords: MFPMM**,** productivity, profitability, pan, multiple linear regression.

INTRODUCTION

Based on March 2021 data from the Ministry of Cooperatives and Small and Medium Enterprises (Ministry of Cooperatives and SMEs), the number of MSMEs in the country has reached 64.2 million with a contribution to the Gross Domestic Product (GDP) of 61.07 percent or IDR 8,573.89 trillion. The existence of a large number of MSMEs is a national economic strength. The contribution of MSMEs in non-oil and gas exports in 2010 reached IDR 175.89 trillion. This proves that MSMEs have competitiveness and potential that must be maintained to maintain the continuity of international trade (Ministry of Cooperatives and SMEs of the Republic of Indonesia, 2021). There are several types of MSMEs in Indonesia, one of which is MSMEs engaged in metal casting. WL Aluminum is a form of MSMEs engaged in the metal casting industry. Metal casting products from WL Aluminum consist of various kitchen utensils such as frying pans, *citel*, *soblok*, kettles, etc. Of all the products produced, WL Aluminum produced the most, namely frying pan. WL Aluminum produces various types of frying pans, namely: thin frying pan, super frying pan and polis frying pan. The size of the frying pan also varies greatly, consisting of 10, 11, 12, 13, 14, 15, 16, 18, 20, 22, 24 and 26 sizes. However, lately the production of thin pans has decreased, because many products from thin pans are damaged. Therefore, WL Aluminum has to re-process. WL Aluminum needs to measure the level of product effectiveness and efficiency of resource use. One way to measure the value of the effectiveness and efficiency of a business entity is by measuring productivity. When a company has known its level of productivity, steps can be taken to exercise control over its resources in order to maximize profits.

LITERATURE REVIEW

According to Sumanth (1984) in Fithria & Firdaus (2014) Productivity is related to the effectiveness and efficiency of resource (input) utilization in producing output; where effectiveness is the degree of achievement of the output of the production system while efficiency is a measure that indicates the extent to which the resources used in the production process produce output. Meanwhile, according to Heizer & Render (2001) Productivity measurement is the best way to evaluate a country's ability to provide a good standard of living for its inhabitants. With increased productivity, living standards can improve. With increased productivity, labor, capital and management can receive additional payments. If labor, capital and management are increased without increasing productivity then prices will rise. But on the other hand, price pressure when productivity increases will result in more production with the same number of resources. One of the methods used to measure productivity is by using the Multi Factor Productivity Measurement Model (MFPMM). MFPMM is used to measure productivity and price changes. In particular, the results of measuring productivity and price changes are related to profitability at the functional organizational level (Phusavat & Photaranon, 2006). The MFPMM method considers the effect of price changes on the resources consumed and price changes on output. According to Wazed & Ahmad (2008) The advantages of the MFPMM method include: obtaining the entire integration of productivity measurements, providing audit analysis of past performance, as a control of the performance of the company's current budget and being able to assess and evaluate the effect of profitability as a result of changes in productivity.

METHODS

This research is quantitative research with interview techniques and direct observation. In this study, the research object focused on the production department at WL Aluminum, namely the production department of the smelting and molding section, with the main product targets: thin pans no. 13, 14, 15 and 16.

In measuring productivity at WL Aluminium, researchers used the Multi Factor Productivity Measurement Model (MFPMM) and multiple linear regression. MFPMM is used to determine the value of the productivity index while multiple linear regression is used to determine the relationship between profitability and productivity and price recovery. The following is the format and equation used in the MFPMM method:

Table 1. MFPMM Format

	Period 1			Period 2			Weighted change ratio			Cost / revenue ratio		Productivity ratios		Weighted performance indexes			Rand effects on profits		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Outputs																			
Summation of outputs																			
Inputs																			
Labour																			
Material																			
Energy																			
Investment																			
Services																			
Other																			
Summation of all inputs																			
Difference																			

Source: Sink, 1985

Table 2. MFPMM Column Description

Column	Description	Equality
1	represents the quantity of output and quantity of input used in making output for period 1 (Qi1). Where i indicates different categories for both input and output.	
2	represents the price of each unit of output and the cost of each unit of input in period 1(Pi1).	
3	value in period 1 where value is the multiplication of the quantity by the cost/price per unit. (J)	Column 3=Column 1 x Column 2 (1)
4	represents the quantity of output and input quantity used to produce output in period 2 (Qi2).	
5	Represents the price of output per unit and the cost of input per unit in period 2 (Pi2).	
6	value in period 2 where value is the multiplication of the quantity with the cost/price per unit. (j)	Column 6=Column 4 x Column 5 (2)
Columns 7, 8 and 9 are Weighted Changer Rations (WCR) calculation columns		
7	The weighted price and price index of the basic period of change in quantity (both unit prices and costs remain constant in period 1.	$\frac{\sum_{i=1}^{n}(Qi2)(Pi1)}{\sum_{i=1}^{n}(Qi1)(Pi1)}$ (3)
8	Weighted quantity index and current period against changes in unit prices and costs (both output and input quantities remain constant in period 2)	$\frac{\sum_{i=1}^{n}(Q2)(Pi2)}{\sum_{i=1}^{n}(Qi2)(Pi1)}$ (4)
9	Examine the impact of changes in price and quantity from period 1 to 2. Quantity for (output and input) and cost per unit are considered not constant.	$\frac{\sum_{i=1}^{n}(Qi2)(Pi2)}{\sum_{i=1}^{n}(Qi1)(Pi1)}$ (5)
Columns 10 and 11 are the Cost Revenue Ratio (CRR) calculation columns		
10	Examine the impact of earnings on period 1	$\frac{Iij1}{\sum_{i=1}^{n}(Qi1)(Pi1)}$ (6)
11	Examine the impact of earnings in period 2	$\frac{Iij2}{\sum_{i=1}^{n}(Qi2)(Pi2)}$ (7)
Columns 12 and 13 are Productivity Ratio (PR) calculation columns		
12	Examine the output-input ratio in period 1	$\frac{\sum_{i=1}^{n}(Qi1)(Pi1)}{(Iij1)(Pij1)}$ (8)

Column	Description	Equality
13	Examine the output-input ratio in period 2	$\frac{\sum_{i=1}^{n}(Qi2)(Pi1)}{(Iij2)(Pij1)}$ (9)
Columns 14, 15 and 16 are Weighted Performance Indexes (WPI) calculation columns		
14	Reflects a price weighted productivity index	$\frac{\sum_{i=1}^{n}(Qi2)(Pi1) / \sum_{i=1}^{n}(Qi1)(Pi1)}{(Iij2)(Pi1)/(Iij1)(Pi1)}$ (10)
15	Represents a price recovery weighted quantity index	$\frac{\sum_{i=1}^{n}(Qi2)(Pi2) / \sum_{i=1}^{n}(Qi2)(Pi1)}{(Iij2)(Pi2)/(Iij2)(Pi1)}$ (11)
16	Describes the profitability index and reflects the average change in both the quantity produced or the quantity used to produce the output and the cost or selling price per unit.	$\frac{\sum_{i=1}^{n}(Qi2)(Pi2) / \sum_{i=1}^{n}(Qi1)(Pi1)}{(Iij2)(Pi2)/(Iij1)(Pi1)}$ (12)
Columns 17, 18 and 19 are the Rupiah In Profit calculation columns		
17	Indicates the potential gain/loss impact of productivity changes.	$\lvert(Iij1)(Pij)\rvert \left\lvert\left(\frac{\lvert\sum_{i=1}^{n}(Qi2)(Pi1)\rvert}{\Sigma(Qi1)(Pi1)}\right) - \left(\frac{(Iij2)(Pi1)}{(Iij1)(Pi1)}\right)\right\rvert$ (13)
18	Indicates the impact of price changes	Column 18=Column 19-Column 17 (14)
19	Indicates the overall impact on gains from productivity or price changes.	$\lvert(Iij1)(Pij)\rvert \left\lvert\left(\frac{\lvert\sum_{i=1}^{n}(Qi2)(Pi2)\rvert}{\Sigma(Qi1)(Pi1)}\right) - \left(\frac{(Iij2)(Pi2)}{(Iij1)(Pi1)}\right)\right\rvert$ (15)

Source: Sink, 1985

Information

Qi1: *output* in period 1 Pi1: price/ cost of input/output *in* period 1 Iij1: quantity of *input* period 1
Qi2: *output* in period 2 Pi2: price/ cost of input/output period 2 Iij2: quantity of *input* period 2

RESULT AND DISCUSSION

According to Phusavat (2013) the data needed to measure productivity using the MFPMM is data for several periods for input and output such as monthly, yearly and weekly. The concept used for analysis of measurements with MFPMM is by comparison between one period and another. Period one as the base period, and the next period is the measured period. So that the determination of the basic period in this study is:

Table 3. Determination of the basic period and the measured period

Basic Period	Measured Period	Measurement
October	November	October-November
November	December	November-December
December	January	December-January
January	February	January-February
February	March	February-March
March	April	March-April
April	May	April-May

After determining the basic period and the measurable period, productivity calculations are carried out using the formula equations 1 to 15. The following is an example of calculating productivity in the period October 2015- November 2015.

Table 4. Calculation results with the MFPMM

	OCTOBER (PERIODE 1)			NOVEMBER (PERIODE 2)			WCR			CRR		PR		WPI			RUPIAH EFECT ON PROFIT		
	Q (O)	P (P)	V (J)	Q (O)	P (P)	va(J)	Q(O)	P(P)	V (J)	PRD 1	PRD 2	PRD 1	PRD 2	Q (O)	P (P)	V (J)	Q (O)	P(P)	v (J)
OUTPUT (Q)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Pans no.13 (unit)	975	16.200	15.795.000	301	16.200	4.876.200	0,3	1,0	0,3										
Pans no.14 (unit)	1.314	19.450	25.557.300	413	19.450	8.032.850	0,3	1,0	0,3										
Pans no.15 (unit)	1.113	21.950	24.430.350	300	21.950	6.585.000	0,3	1,0	0,3										
Pans no.16 (unit)	847	25.350	21.471.450	295	25.350	7.478.250	0,3	1,0	0,3										
TOTAL			87.254.100			26.972.300	0,3	1,0	0,3										
INPUT (I)																			
Labor																			
labor (daily)* 1 month=24 days	15	75.000	12.375.000	15	75.000	3.375.000	0,3	1,0	0,3	0,1	0,1	7,1	8,0	1,1	1,0	1,1	450404,3	0,0	450404,3
TOTAL			12.375.000			3.375.000	0,3	1,0	0,3	0,1	0,1	7,1	8,0	1,1	1,0	1,1	450404,3	0,0	450404,3
RAW MATERIAL																			
ingot (kg)	2.237	23.500	52.563.860	663	23.500	15.580.970	0,3	1,0	0,3	0,6	0,6	1,7	1,7	1,0	1,0	1,0	667758,7	0,0	667758,7
block (kg)	238	22.000	5.228.960	85	22.000	1.862.080	0,4	1,0	0,4	0,1	0,1	16,7	14,5	0,9	1,0	0,9	-245685,2	0,0	-245685,2
crepes (kg)	1.016	22.000	22.353.760	364	22.000	8.004.920	0,4	1,0	0,4	0,3	0,3	3,9	3,4	0,9	1,0	0,9	-1094845,6	0,0	-1094845,6
talc	0	80.000	1.586	0	80.000	432	0,3	1,0	0,3	0,0	0,0	55023,5	62366,6	1,1	1,0	1,1	57,7	2854,0	2911,7
dipper	12	22.000	264.000	3	22.000	66.000	0,3	1,0	0,3	0,0	0,0	330,5	408,7	1,2	1,0	1,2	15608,6	0,0	15608,6
paintbrush	24	10.500	252.000	6	10.500	63.000	0,3	1,0	0,3	0,0	0,0	346,2	428,1	1,2	1,0	1,2	14899,1	0,0	14899,1
total			80.664.166			25.577.402	0,3	1,0	0,3	0,9	0,9	1,1	1,1	1,0	1,0	1,0	-642206,6	0,0	-642206,6
ENERGY																			
electricity (kwh)	131	1.100	144.092	36	1.100	39.298	0,3	1,0	0,3	0,0	0,0	605,5	686,4	1,1	1,0	1,1	5244,4	0,0	5244,4
oil (drum)	22	375.000	8.250.000	6	375.000	2.250.000	0,3	1,0	0,3	0,1	0,1	10,6	12,0	1,1	1,0	1,1	300269,6	0,0	300269,6
gas (liter)	80	7.300	584.000	20	7.300	146.000	0,3	1,0	0,3	0,0	0,0	149,4	184,7	1,2	1,0	1,2	34528,2	0,0	34528,2
solar (liter)	220	6.900	1.518.000	60	6.900	414.000	0,3	1,0	0,3	0,0	0,0	57,5	65,2	1,1	1,0	1,1	55249,6	0,0	55249,6
TOTAL			10.496.092			2.849.298	0,3	1,0	0,3	0,1	0,1	8,3	9,5	1,1	1,0	1,1	395291,7	0,0	395291,7

	OCTOBER (PERIODE 1)			NOVEMBER (PERIODE 2)			WCR			CRR		PR		WPI			RUPIAH EFECT ON PROFIT		
	Q (O)	P (P)	V (J)	Q (O)	P (P)	va(J)	Q(O)	P(P)	V (J)	PRD 1	PRD 2	PRD 1	PRD 2	Q (O)	P (P)	V (J)	Q (O)	P(P)	v (J)
TOTAL INPUT			103.535.257			31.801.700	0,3	1,0	0,3	1,2	1,2	0,8	0,8	1,0	1,0	1,0	203489,5	0,0	203489,5

The following is a summary of the results of productivity calculations using the MFPMM method from October 2015 to May 2016

Table 5. Productivity Summary

PERIOD	TOTAL PRODUCTIVITY		IP	%	WPI			REP		
	PERIOD 1	PERIOD 2	(P2/P1)		Change in productivity	change in price recovery	Change in profitability	productivity	price recovery	profitability
OKT-NOV	0,84	0,85	1,01	100,64%	1,01	1	1,01	203489,51	0,00	203489,51
NOV-DES	0,85	1,05	1,24	123,70%	1,24	1	1,24	25020060,65	0,00	25020060,65
DES-JAN	1,05	0,9	0,85	85,45%	0,85	1	0,86	-6233085,87	164000,00	-6069085,87
JAN-FEB	0,9	0,81	0,9	90,16%	0,90	1	0,90	-4322787,65	0,00	-4322787,65
FEB-MAR	0,81	0,78	0,96	96,07%	0,96	1	0,96	-2230455,72	-8000,00	-2238455,72
MAR-APR	0,78	0,86	1,11	110,68%	1,11	1	1,11	2345989,06	64000,00	2409989,06
APR-MAY	0,87	0,64	0,73	73,48%	0,73	1	0,73	-10402617,03	0,00	-10402617,03

From the table above it can be seen that the highest total IP value occurred in the November 2015-December 2015 measurement period with an IP value of 1.2370 (123.70%) and the lowest occurred in the April 2016-May 2016 measurement period of 0.7348 (73.48). %). Factors that affect the level of productivity at WL Aluminum consist of labor factors, raw materials, work methods and energy used in the production process. Meanwhile, the lowest total IP value occurred in the April 2016-May 2016 measurement period with a total IP value of 0.7348 (73.48%). IP for each input variable is 0.752 for labor, 0.723 for raw material IP and 0.760 for energy IP. The decrease in the productivity index occurs due to inefficiency in the use of resources in producing pans so that the number of pans produced is not optimal, sometimes the workers also do not work according to the existing work methods. In addition, the quality of raw materials also greatly affects the quality of the product because if the raw materials are of poor quality, it will have an impact on the products produced, namely experiencing many corrosion defects, holes, and windows so that a re-smelting process needs to be carried out which results in inefficiency in the use of energy resources. as well as labor. In addition to the quality of raw materials, the method of smelting raw materials that do not fit (lack of heat) also affects the quality of the product. If the pool of raw materials has a temperature below 8000C it can also have the opportunity to give a defective product.

The value of the WPI change in productivity is > 1, this indicates that the level of output quantity produced is faster than the rate of quantity of input consumed from period 1 to period 2 (Phusavat, 2013). From table 5 it is known that in the measurement period October 2015 (period 1) - November 2015 (period 2) it was 1.0064; November 2015 (period 1) - December 2015 (period 2) of 1.2370; and March 2016 (period 1) - April

2016 (period 2) of 1.1068 has a WPI value change in productivity > 1 so that in this measurement period it can be said that the rate of quantity of output produced is faster than the rate of quantity of input consumed from the period 1(base period) to period 2(measured period). If the WPI change in price recovery > 1 then it shows that there is a profit obtained by the company. This indicates that the rate of change in output prices is faster than the rate of change in unit costs for all inputs. From table 5 it is known that in the measurement period December 2015-January 2016 it was 1.0038 and March 2016-April 2016 it was 1.0029, this period has a value WPI change in price recovery > 1, it can be said that in the measurement period the gain is made as a result of the rate of change in output prices being faster than the rate of change in unit costs for all inputs.
Based on the test results using multiple linear regression which are processed simultaneously it can be concluded that profitability is significantly influenced by the productivity and price recovery variables, as evidenced by the F test, that F count > F table, 1401891.948 > 6.94 as for the mathematical equation model: profitability = - 0.952 + 1.001 productivity + 0.951 price recovery the higher the productivity obtained by WL aluminum, the profit received will also be higher, as well as price changes which have a higher value will also affect the profit received

CONCLUSIONS

Based on the results of interviews with the head of the WL Aluminum production section, the factors that support the productivity of thin pans of sizes 13, 14, 15 and 16 include labor, raw materials (blocks, ingots, pans, brushes, scoops and talc) and energy (gasoline, diesel and oil). the results of calculations using the MFPMM method show that the productivity index in the WL Aluminum production section in a row during the October-November 2015 measurement period was 1.0064; the November-December 2015 measurement period was 1.2370; the measurement period December 2015-January 2016 is 0.8545; the measurement period January-February 2016 is 0.9016; the measurement period February-March 2016 was 0.9607; the measurement period March-April 2016 was 1.1068; the April-May 2016 measurement period was 0.7348. It is known that the April 2016-May 2016 measurement period had the lowest IP, namely 0.7348, this decreased by 0.3720 from the previous measurement period, namely March 2016-April 2016 which had a total IP of 1.1068. Based on the results of calculations with multiple linear regression using SPSS 16 software which is processed simultaneously it is known that the profitability of aluminum WL is significantly influenced by productivity and price recovery. This is evidenced by the results of the statistical F test on F count 1401891.948 with a p-value of 0.000, which means 0.000 <0.05. The causes of a decrease in productivity include: SOPs in the production section that are not clear, the quality of raw materials from suppliers which are sometimes mixed with iron which causes the pan products to corrode and are unfit for sale, as well as the process of smelting raw materials that are not quite right.

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